Addendum to GEOTECHNICAL BASELINE REPORT

Carolina Crossroads Phase 3C
Lexington County, South Carolina

PREPARED FOR
HDR, Inc.
1201 Main Street, Suite 800
Columbia, South Carolina 29201

PREPARED BY
F&ME Consultants, Inc.
211 Business Park Blvd.
Columbia, South Carolina 29203

SCDOT Project ID: P043325
F&ME Project No. G5662.03

SEPTEMBER 10, 2024

September 10, 2024

Dr. Lee Tupper, PhD, PE
HDR, Inc.
1201 Main Street, Suite 800
Columbia, South Carolina 29201

Re: Addendum to Geotechnical Baseline Report
Geophysical Test Results at Carolina Crossroads – Phase 3C
Lexington County, South Carolina
SCDOT Project ID: P043325
F&ME Project No.: G5662.03

Dr. Tupper:

Submitted herein is F&ME Consultants, Inc's (FME) Addendum to the previously submitted Geotechnical Baseline Report (GBR) for the Phase 3C portion of the Carolina Crossroads project. This addendum includes geophysical testing that was performed near the proposed sewer force main pipe near the CSX railroad bridge location. Included is a summary of the geophysical testing performed and our interpretation of the performed geophysical testing relative to construction of the proposed force main pipe.

Please notify us if there are any questions.

Sincerely,

F&ME CONSULTANTS

Digitally signed by John Hamilton
Date: 2024.09.10 18:44:05-04'00'

John F. Hamilton, PE
Geotechnical Design Manager

Attachments

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APPENDIX

1. PROJECT DESCRIPTION

The project is located near Columbia, South Carolina. A site location plan is presented in the Appendix.

The Phase 3C project consists of widening Interstate 20 southwest of the intersection of Interstate 26 and Interstate 20. The project generally extends approximately two (2) miles along I-20, from the US 378 interchange to the Bush River Road interchange. Two (2) existing bridges are designated for replacement within the Phase 3C project corridor to facilitate the interstate widening: the I-20 bridge over the Saluda River and the I-20 bridge over CSX Railroad.

Based on the conceptual plans, an existing 30-inch diameter sewer force main pipe, located near the beginning of the CSX Railroad bridge, is proposed to be re-located. The proposed force main pipe will utilize trenchless excavation techniques (ie. jack-and-bore) to install the pipe under the existing I-20 embankment. The purpose of the geophysical work, discussed herein, was to investigate the potential for encountering boulders, weathered rock, and/or hard rock within the proposed installation depths of the new force main pipe.

The geophysical subsurface investigation was performed in general accordance with the 2022 SCDOT Geotechnical Design Manual (GDM) and/or applicable ASTM standards.

2. GEOPHYSICAL SUBSURFACE EXPLORATION

A geophysical subsurface investigation was performed near the proposed sewer force main location, near the CSX Railroad crossing. Two (2) geophysical test methods were performed: Seismic Refraction Testing and Electrical Resistivity (ER) Testing. For each type of geophysical testing, four (4) arrays were performed along the general alignment of the proposed force main pipe. The ER arrays were limited to the areas outside of the toes of the existing I-20 embankment. The refraction arrays extended up the existing embankment side slopes some amount. The locations of the geophysical testing are provided in Section 2 of the Appendix.

2.1. SEISMIC REFRACTION

From July 12-16, 2024, seismic refraction geophysical testing was performed near the proposed sewer force main alignment. A Geometrics ES-3000 - 24 channel seismograph was used to collect the geophysical data. The refraction testing was generally performed at the same locations as the ER testing. Multiple energy input locations were performed along each array. At each energy input location, the striker plate was impacted a minimum of five (5) times, and the data was "stacked" for processing by the software. "Stacking" is utilized to increase the signal to noise ratio. The field data processing begins by "picking first breaks". This initial step involves determining when the signal/energy from the hammer striking the plate reaches each geophone. This procedure is repeated for each shot point. A curve is then generated representing arrival times at each geophone. All the curves from each survey line are then combined. These curves are then processed using the refraction analysis software. Subsequently, the tomographic method was used to create a two-dimensional image of seismic velocity.

Comparing the results of the seismic refraction testing performed on the eastern side of I-20 to the nearby geotechnical borings, we consider the seismic refraction testing to be inconclusive on that side of I-20. We interpret the inconclusive testing to be a result of a nearby pathway consisting of concrete debris overlying the soft, alluvial deposits. The concrete debris was dominating the response of the shear waves travelling through the earth and artificially increasing the velocities. The seismic refraction testing performed west of I-20 is considered to be more accurate relative to measuring the subsurface shear wave velocities. The results from the seismic refraction testing are provided in the Appendix.

2.2. ELECTRICAL RESISTIVITY

On July 12, 2024, FME performed Electrical Resistivity (ER) testing at the site. For the ER testing, F&ME utilizes the SuperSting Earth Resistivity System manufactured by Advanced Geosciences, Inc. (AGI). The system consists of the SuperSting eight-channel resistivity meter and a multi-electrode cable with 42 electrodes at nine feet spacing and an automatic switching unit. The eight channels allow eight resistivity measurements to be taken simultaneously. The electrodes are "grounded" at the desired design electrode spacing utilizing steel spring clips and stakes pushed into the ground subgrade.

The basic principle of electrical resistivity imaging is that all materials have physical characteristics, which determine how well, or poorly, the material can conduct an electrical current. The current is injected at two points and then measured at other pre-determined points depending upon the array arrangement for the selected in-situ measurement methodology. Analysis of the potential electrical current drops between electrodes using a finite difference algorithm allows a determination of the resistance of the subsurface material (expressed as ohms per meter).

Resistivity values of soil and rock are affected by mineral composition, porosity, moisture, dissolved electrolytes, and temperature. Soils generally have low resistivity values, whereas rock has a relativity high resistivity value. A soil or rock resistivity can vary greatly depending on whether it is wet or dry. Because of overlap in the range of resistivity for various materials, this method is used in conjunction with other geotechnical methods to verify data interpretation.

The "resolution" that the ER equipment can detect is a function of the electrode probe spacing. In general, objects and specific soil strata that are smaller or thinner than one-half the individual electrode probe spacing may not be easily discernable. The depth of investigation that ER data acquisition is capable of is a function of the total survey line length. The depth that can be interpreted with a reasonable resolution is approximately one-fourth to one-fifth of the total survey line length.

3. INTERPRETATION OF GEOPHYSICAL TESTING

We interpret the results from the performed geophysical testing to indicate that weathered rock or bedrock should not be encountered during the trenchless excavation for the proposed force main sewer pipe. At the worst-case location, we estimate the bottom of the proposed pipe is approximately ten (10) feet above the top of Intermediate Geo-Material (IGM) elevation. We consider IGM to be a soil type material with SPT blow counts in excess of 100 blows per foot. We should note that the geophysical testing gives an approximation of the subsurface conditions and should not be used as an absolute indicator.

In this geologic area, we cannot definitively state that boulders will not be encountered. In our opinion, we cannot conceivably think of an investigative technique for which one could state that boulders will not be encountered. We feel that amount of investigation that has been performed at the proposed sewer force main location is above and beyond what would typically be performed for a structure of this type prior to release of the Design-Build Request for Proposals (RFP).

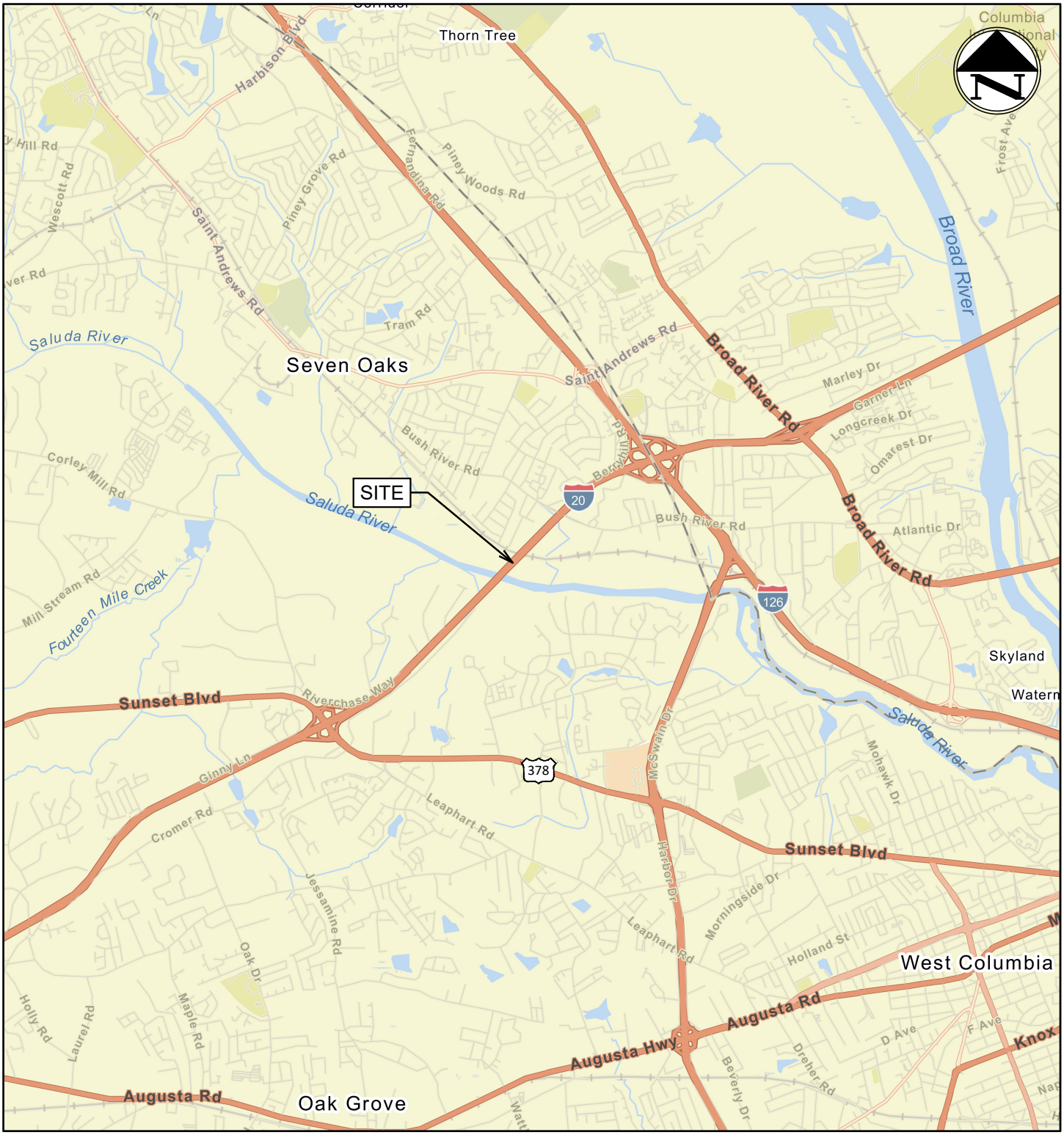
4. LIMITATIONS OF REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to the referenced project. The interpretations, contained herein, are based upon the provided soil borings and geophysical test data and applicable standards in this geographic area at the time this report was prepared. No other warranty, expressed or implied, is made.

APPENDIX

APPENDIX

SECTION 1 SITE LOCATION PLAN



1:72,000

0 0.5 1 2 mi

0 0.75 1.5 3 km

F&ME CONSULTANTS, INC.
COLUMBIA, SC

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R/W _____ DATE _____

CAROLINA CROSSROADS PHASE 3C PROPOSED FORCE MAIN
LEXINGTON COUNTY, SOUTH CAROLINA

SITE LOCATION PLAN

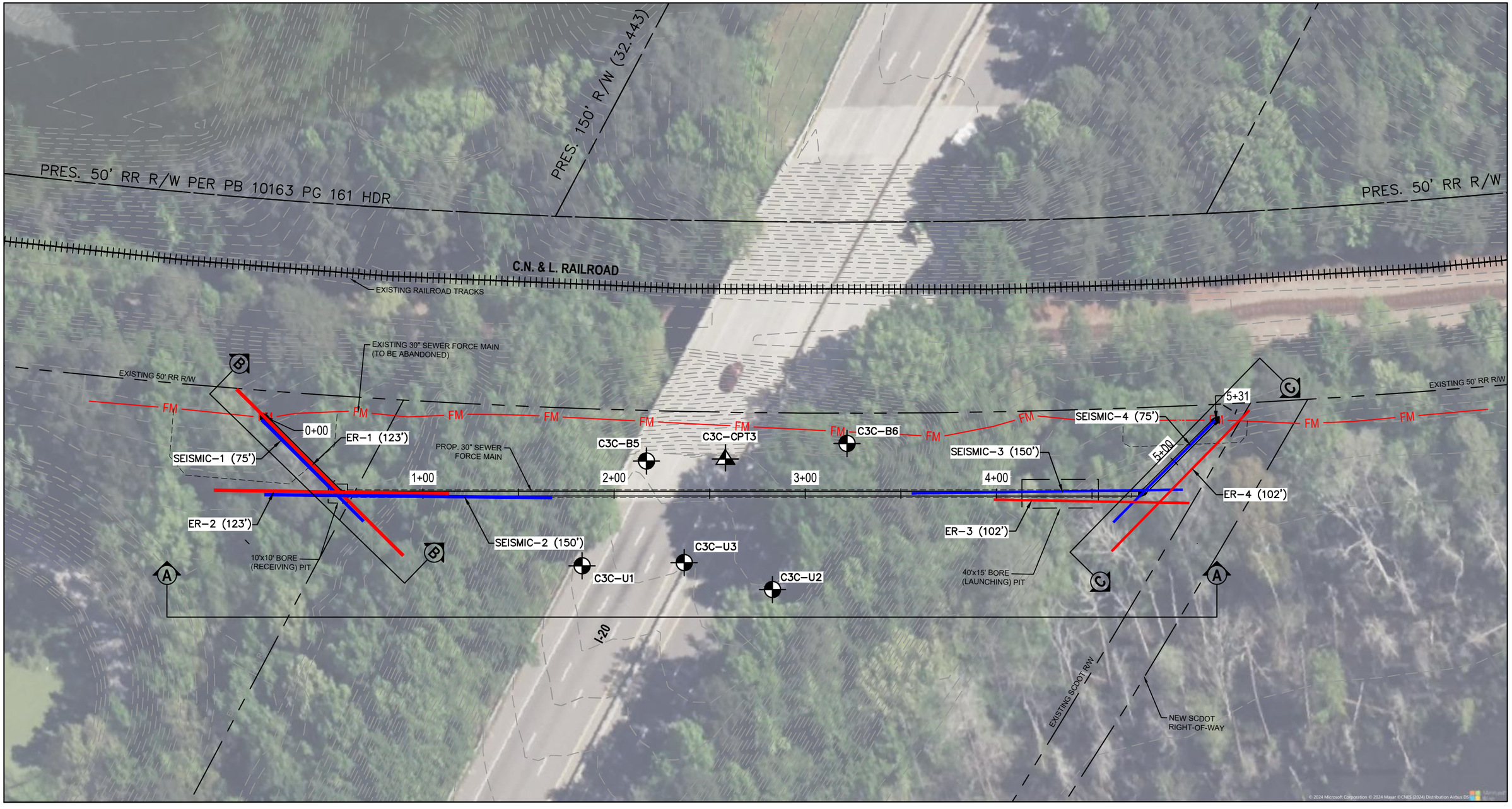
FME JOB NO. G5662.030

SCALE: AS NOTED

FIGURE 1

APPENDIX

SECTION 2 GEOPHYSICAL TESTING LOCATION PLAN



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CAROLINA CROSSROADS PHASE 3C PROPOSED FORCE MAIN
LEXINGTON COUNTY, SOUTH CAROLINA

GEOPHYSICAL TESTING LOCATION PLAN

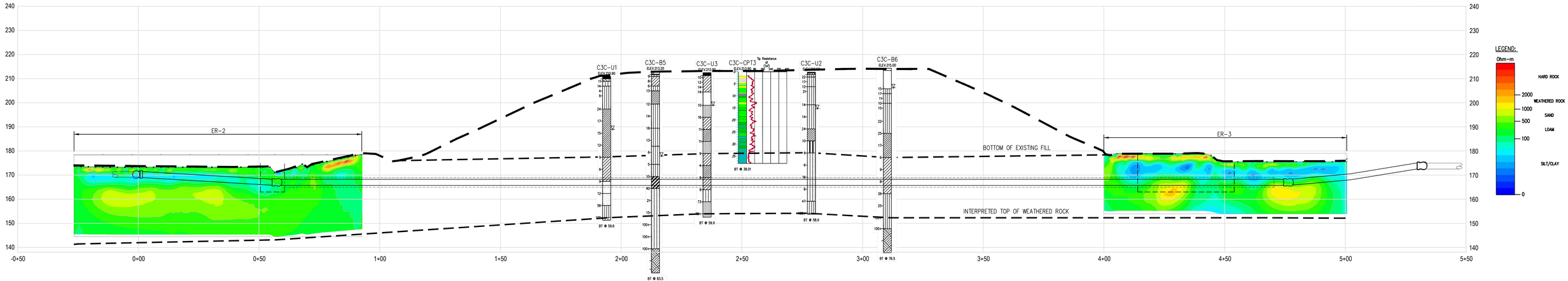
SCALE: 1" = 50'

FME JOB NO. G5662.030

FIGURE 2

APPENDIX

SECTION 3 ELECTRICAL RESISTIVITY SECTIONS



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CAROLINA CROSSROADS PHASE 3C PROPOSED FORCE MAIN
LEXINGTON COUNTY, SOUTH CAROLINA

GEOPHYSICAL ER SECTION A-A

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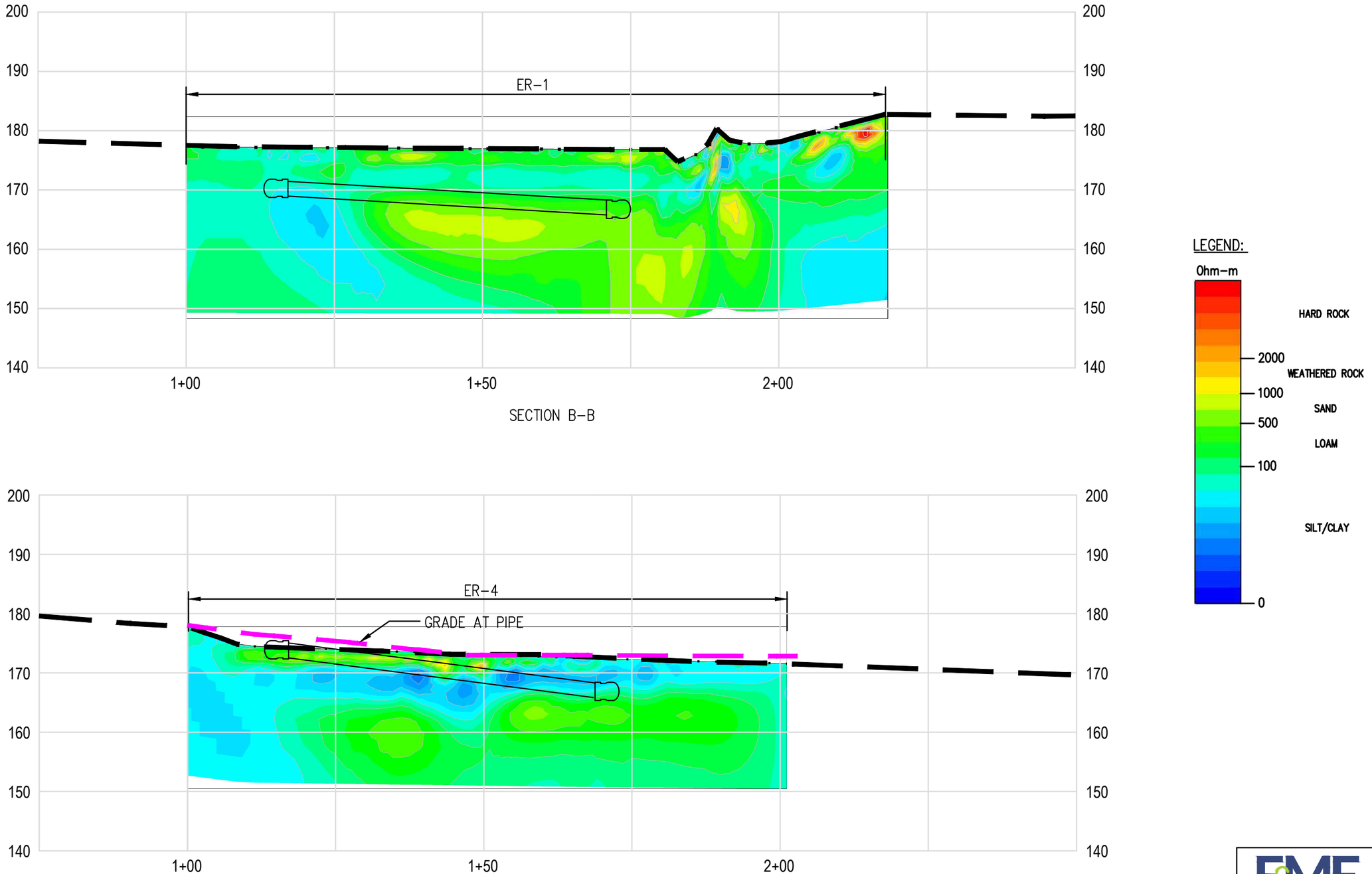
FME JOB NO. G5662.030
SCALE: NTS
FIGURE 3



SECTION B-B

SECTION C-C

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COLUMBIA, SC

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CAROLINA CROSSROADS PHASE 3C PROPOSED FORCE MAIN
LEXINGTON COUNTY, SOUTH CAROLINA

GEOPHYSICAL ER SECTION B-B & C-C

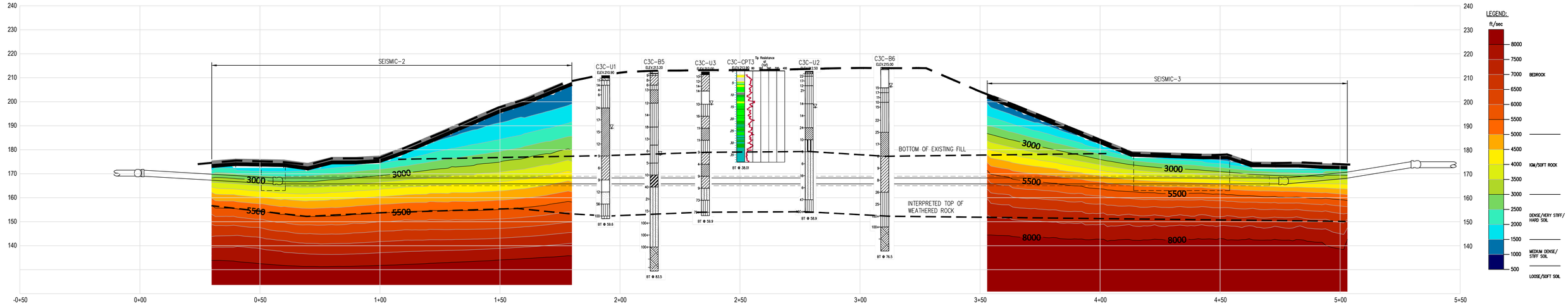
SCALE: NTS

FME JOB NO. G5662.030

FIGURE 4

APPENDIX

SECTION 4 SEISMIC REFRACTION SECTIONS



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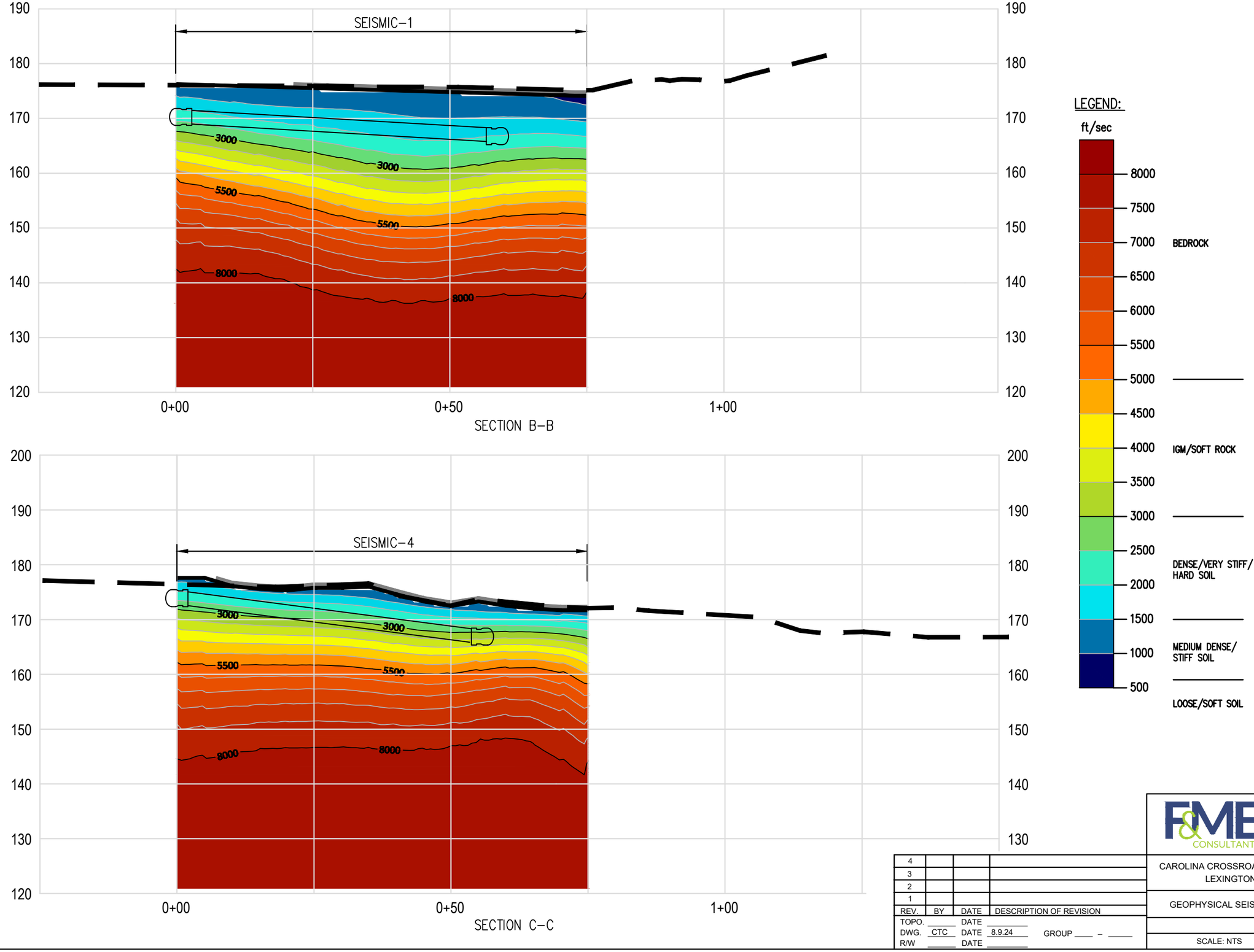
CAROLINA CROSSROADS PHASE 3C PROPOSED FORCE MAIN
LEXINGTON COUNTY, SOUTH CAROLINA

GEOPHYSICAL SEISMIC REFRACTION SECTION A-A

FME JOB NO. G5662.030

SCALE: NTS

FIGURE 5



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CAROLINA CROSSROADS PHASE 3C PROPOSED FORCE MAIN
LEXINGTON COUNTY, SOUTH CAROLINA

GEOPHYSICAL SEISMIC REFRACTION SECTION B-B & C-C

FME JOB NO. G5662.030

SCALE: NTS

FIGURE 6